Space Weather Technical Forecast

Issued on Saturday, 12 August 2023 at 13:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares possible throughout. G1/Minor Storm risk mainly day 3 (14 Aug)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C8.8 at 012/0915 UTC from AR3395 in the northwest. There are four active regions on the visible disc, three of which are numbered. The main flare risk continues to be from AR3395, which despite its modest size has maintained some complexity with small delta spots persisting. Consolidation of smaller spots has also resulted in the development of umbra on its small component spots, however growth of this region has stalled. AR3394 in the southwest remains stable, while AR3397 also in the northwest has persisted as a smaller and simpler region. There are no Earth-directed CMEs.

Solar Wind / Geomagnetic Activity: Solar winds are indicative of a weak negative polarity high speed stream. The observed speed by ACE and L1 remained slightly elevated around 450 km/s with below average density. The total interplanetary magnetic field (IMF), Bt, remained weak, below 8nT. The north-south component, Bz, was erratic and weak between +6 and -6nT, but with a slight favouring towards positive (northward) values. Phi angle remained negative (towards the Sun). Geomagnetic activity was Quiet throughout (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux continued erratically easing from 1 pfu to near background levels. This enhancement was due to the 07 Aug X1.5 flare from AR3386 (now on the far-side), which peaked on 09 Aug at S1. High energy (greater than 2MeV) electron flux at GOES16 ranged from background to high, peaking at 1390pfu at 11/1745UTC. The associated 24-hour integrated fluence remained below the Active level (1e8 integrated pfu), with a very slight rising trend to reach 4.84e7 integrated pfu at 12/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected, with a chance of isolated M-flares, predominately from AR3395 in the northwest.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. The next fast wind enhancement is expected to be from the arrival of the HSS of CH33/+, most likely on day 3 (14 Aug) with speeds potentially reaching 500-600km/s. Initially mainly Quiet geomagnetic activity is expected to become Active to G1 Minor Storm, most likely day 3 (14 Aug), easing again later day 4 (15 Aug).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV at GOES16) is expected to continue declining erratically towards Background, with only a very slight chance of rising in response to any flares from AR3395. The high energy electron flux (greater than 2MeV at GOES16) is expected to continue varying between Background and High until the onset of CH33/+ when flux will potentially fall to persistently Background levels. Flux perhaps rising to be more persistently Moderate to High as the solar wind eases day 4 (15 Aug). The associated 24 hour fluence is expected to remain below the Active threshold (1e8 integrated pfu) through this period, but likely rising day 4 (15 Aug).

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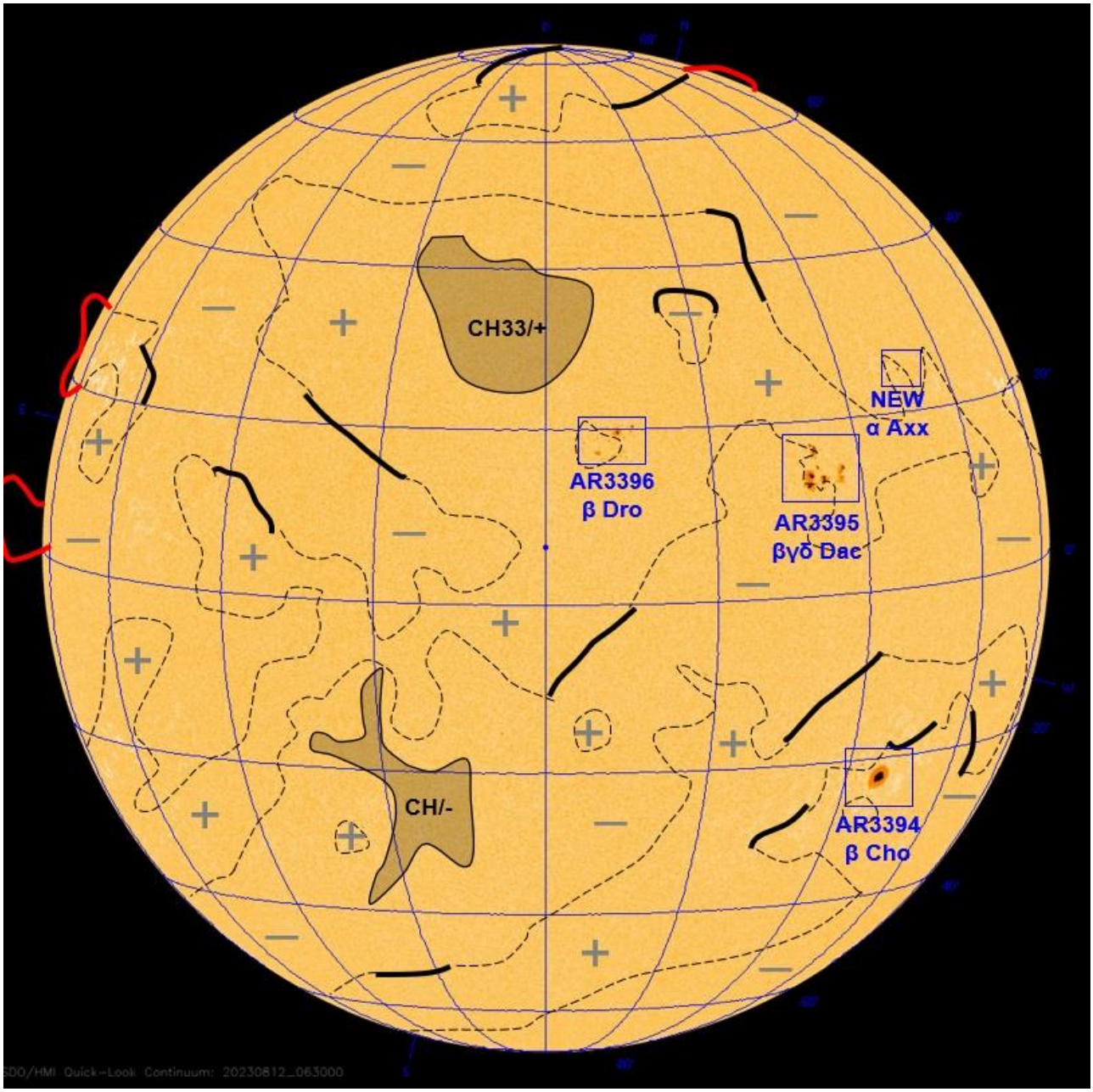
Figure 1. Solar Analysis Valid 12/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

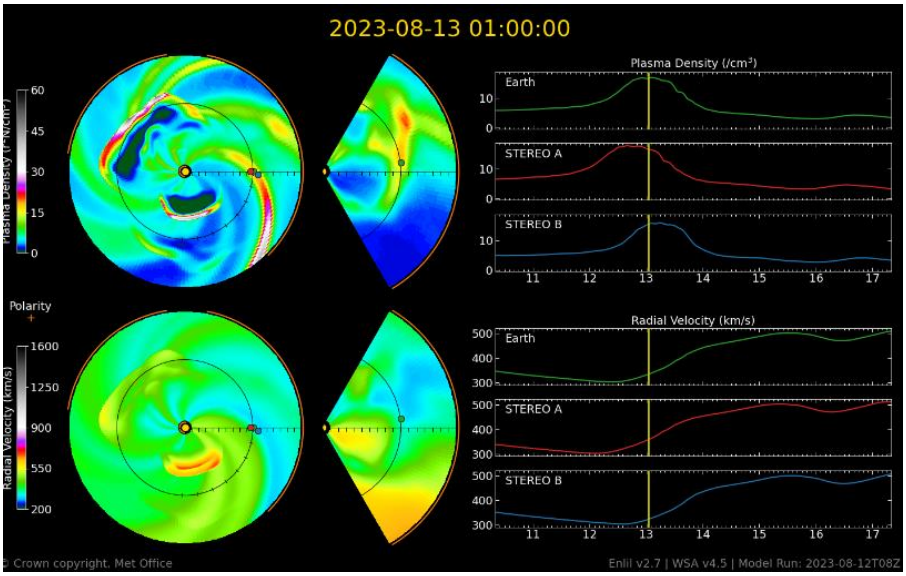
There are no Earth-directed CMEs.

The only fast wind source to feature in the forecast period is that from CH33/+, now near the solar meridian in the northern hemisphere. While this feature was present in some form on the previous rotation, it is now significantly larger and has retrogressed, and is expected to be more intense on this occasion. The latest iteration of MOSWOC Enlil has this feature as arriving as early as late on day 2 (13 Aug), before gradually rising to a peak wind speed of around 500km/s. However this is felt to be a little early for its visible location, with a more likely arrival on day 3 (14 Aug) and any increased geomagnetic activity perhaps continuing into the day 4 (15 Aug).

Geomagnetic activity is forecast to be mainly Quiet, until this enhancement occurs, but likely increasing to Active to G1 Minor Storm on day 3 (14 Aug), before easing on day 4 (15 Aug) to mainly Quiet with unsettled spells by the end of the forecast period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	60	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enlil showing enhancement on 13 Aug, however this is considered too early, with onset more likely on 14 Aug.



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Radio Blackouts - X-Ray Flares:

Solar Activity is currently Low, with peak flare C8.8 at 12/0915 UTC from AR3395. This is one of four active regions currently on the visible disc, with a general trend downwards currently being observed with the number of sunspots.

AR3395, located on the northwest disc remains the main source of potential flare activity, as a complex region with at least three delta spots identifiable. This is a small active region however, with isolated M-flares most likely. AR3394 in the southwest is the other main region of note, dominated by a mature large spot but has seen some peripheral spots decline and remains stable. AR3397 is a smaller region, just moving into the northwest disc, with any growth having now stalled, whilst the final spot is a small unipolar spot also in the northwest.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	50	40	40
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3a: GOES-16/18 X-ray Flux

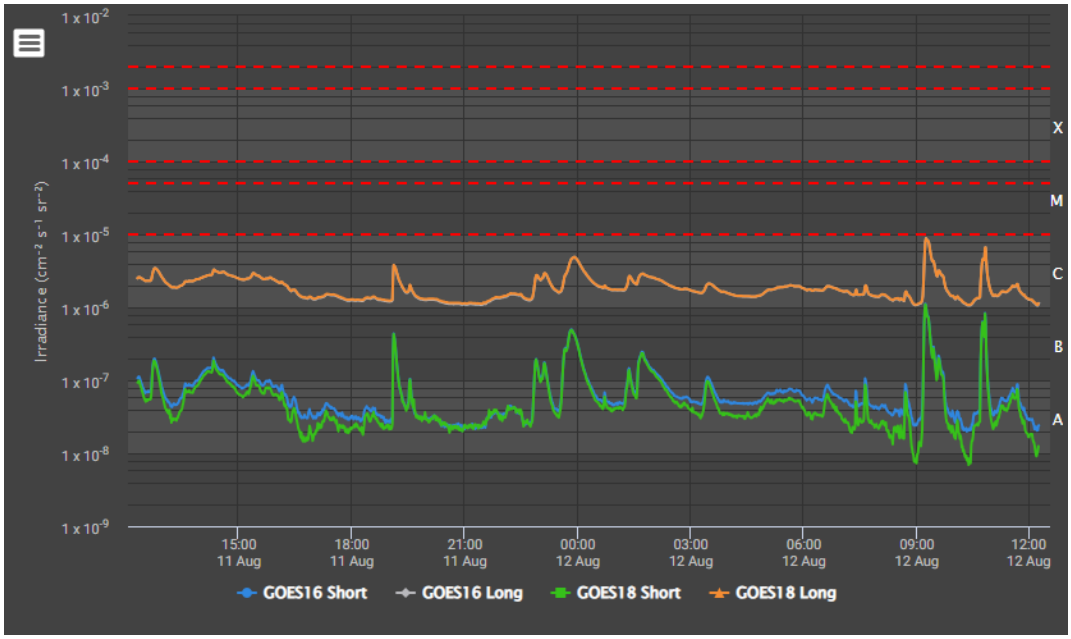

Figure 3b: SDO Intensitygram and Magnetogram of AR3395

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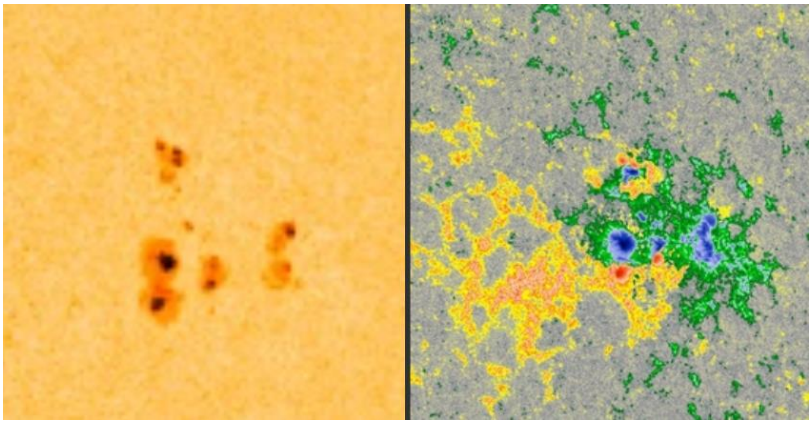
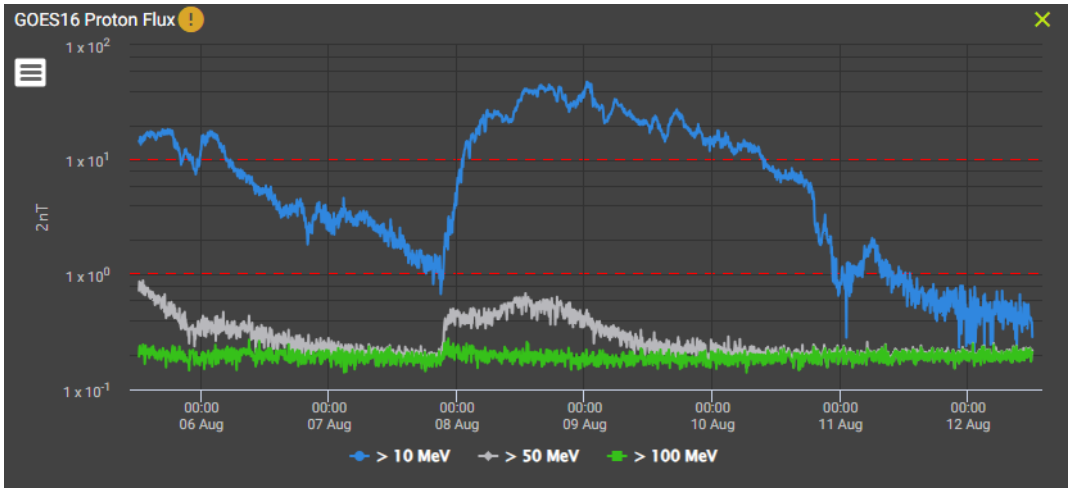


Solar Radiation Storms - (High Energy Protons):

The flux of high energy (greater than 10 MeV) is well below the S1 Minor Storm level and easing, but remains slightly above Background after the enhancement on 08 Aug. There remains a daily slightly chance of further enhancements due to any notable flares from AR3395 in the northwest, and a lower risk from AR3394 in the southwest.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-16 >10MeV >50 MeV and >100 MeV proton flux over last 7 days,



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High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is expected to be mainly at Moderate levels, but showing a diurnal variation from Background to High, likely peaking just over 1000pfu each day. This is likely to be attenuated into the final day of the forecast period due to the increased solar wind pressure from any onset of coronal hole fast winds. Increased flux will then likely follow, perhaps later day 4 (15 Aug) but more likely beyond this forecast period.

The associated fluence is expected to remain below the Active level throughout, but likely rising later day 4 (15 Aug). REFM is currently providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 >2MeV electron flux (top) and associated fluence with REFM (bottom)

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